CLAIMS

1. A microelectrophoresis chip comprising a substrate having formed therein at least one separation channel for performing separation formed on a first major surface, two or more electrodes disposed within the channel to induce an electric field within the channel, characterized in that the channel contains a homogeneous separation medium effective to act as obstacles to migration of biopolymers in a sample applied to the microelectrophoresis chip and in that the microelectrophoresis chip further comprises a detector element disposed on the chip for observation of migrating biopolymers.

2. The chip according to claim 1, wherein the separation channel is from 1 to 10 μm in depth.

3. The chip according to claim 1 or 2, wherein the homogeneous separation medium comprises monodisperse microspheres.

4. The chip according to claim 1 or 2, wherein the homogeneous separation medium comprises water soluble fullerenes.

5. The chip according to claim 1 or 2, wherein the homogeneous separation medium comprises a self-assembling dendrimer.

6. The chip according to any of claims 1-5 wherein the chip has a plurality of separation channels.

7. The chip according to any of claims 1-6 wherein a plurality of anodes and a plurality of cathodes are disposed within each separation channel.

8. The chip according to claim 7, wherein the plurality of anodes and the plurality of cathodes are disposed to generate electric fields in at least two non-parallel directions.

9. A method for manufacturing a microelectrophoresis chip according to any of claims 1 to 8 comprising the steps of

(a) forming a mold using lithography, said mold being the reverse of a desired pattern of channels and separators

(b) casting or imprinting the channels in a polymeric substrate as a negative impression replica of the mold,

(c) fusing the polymeric substrate with the channels formed therein to a solid support;

(d) forming at least two electrodes within each channel; and

(e) filling each channel with a homogeneous separation medium.

10. A method for separating a mixture containing a plurality of species of biopolymers into subclasses of biopolymers comprising the steps of

(a) loading the mixture onto a chip for electrophoretic separation of charged polymers according to any of claims 1 to 8; and

(b) applying an electric field to the chip to cause charged biopolymers in the mixture to migrate within the chip and be separated.

11. The method according to claim 10, further comprising the step of detecting the separated biopolymers within the chip.

12. The method according to claim 11, wherein the separated biopolymers are detected using a fluorescence detector.

13. A method for sequencing nucleic acids comprising the steps of

(a) loading a mixture containing products from a sequencing reaction onto a chip for electrophoretic separation of charged polymers according to any of claims 1- 8,

(b) applying an electric field to the chip to cause charged biopolymers in the mixture to migrate within the chip; and

(c) detecting separated bands of sequencing reaction products.

14. The method according to claim 13, wherein the separated bands are detected using a fluorescence detector.

15. An apparatus for separation of plurality of species of biopolymers into subclasses of biopolymers comprising the steps of

(a) a holder for receiving a chip for electrophoretic separation of charged polymers, said chip according to any of claims 1 to 8; and

(b) a power supply for applying an electric field to the chip to cause charged biopolymers in the mixture to migrate within the chip and be separated.

16. The apparatus according to claim 15, further comprising a detection system for detecting charged separated biopolymers within a chip disposed in the holder.

17. The apparatus according to claim 16, wherein the detection system is a fluorescence detection system.

18. The apparatus according to any one of claims 15 to 17, further comprising a loader for decreasing the volume of a sample to be loaded onto a chip disposed within the holder.

19. The apparatus according to claim 18, wherein the loader comprises a first concentration channel, a first pair of electrodes, a first semipermeable membrane effective to retain the biopolymers while allowing passage of smaller molecules, and a second pair of electrodes, wherein said first semipermeable membrane is located between the first pair of electrodes whereby biopolymers migrating in a first electric field generated within the first concentration channel between the first pair of electrodes are retained on the semipermeable membrane, and wherein the second pair of electrodes generate a second electric field perpendicular to the first electric field for migrating the retained biopolymers from the first semipermeable membrane.

20. The apparatus according to claim 19, further comprising a second concentration channel, a second semipermeable membrane effective to retain the biopolymers while allowing passage of smaller molecules, and a third pair of electrodes, said second pair of electrodes causing the retained biopolymers to migrate from the first semipermeable membrane through the second concentration channel to the second semipermeable membrane, and said third set of electrodes generating a third electric field perpendicular to the second electric field for migrating retained biopolymers from the second semipermeable membrane.

21. The apparatus according to claim 19 or 20, further comprising means for lowering the temperature in a portion of the first concentration channel to form a viscosity trap.

22. The apparatus according to claim 21, wherein the means for lowering the temperature in a portion of the first concentration channel is a thermocouple strip.

23 A microelectrophoresis chip comprising a substrate having formed therein at least one separation channel for performing separation formed on a first major surface, a plurality of anodes and a plurality of cathodes disposed within each separation channel to induce an electric field within the channel, characterized in that the channel contains a homogeneous separation medium effective to act as obstacles to migration of biopolymers in a sample applied to the microelectrophoresis chip and in that the plurality of anodes and the plurality of cathodes are disposed to generate electric fields in at least two non-parallel directions.